

Interaktion

INTERAKTION: Users Group for the Interak Computer.

Newsletter Number 2

March 1983

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Dear reader, since the last issue of our newsletter our "applied for" membership has grown to more than one hundred members, and grows daily. Somehow we have attracted people from as far away as Spain Norway and Sweden, and we are pleased to welcome them.

Greenbank have volunteered to help with the distribution of the newsletter for the time being, and will be circulating copies to several hundred other people whom they have identified as being potential members (i.e. people who are clearly users of the cards but who haven't joined the group). To those users: Fill in an application form now (from me or Greenbank), otherwise you may never get another newsletter!

Although the growth in available software has been slow, exciting things have been happening in the hardware field. Not only has the long awaited 2400 baud tape interface card come on the scene but INTERAK has now moved into the world of disk drives. A prototype disk controller has been built and is happily running 8" drives, giving its owner access to CP/M and all that brings.

Finally let me make a plea to those of you who have developed programs, to let me know so I can enter their specification into our software library.

PV

Byte Bag:

The short piece of coding reproduced here moves a block of data from one location to another without damaging the host program. You must use POKES to place the source and destination addresses and the number bytes to be moved into the locations indicated.	PUSH HL PUSH DE PUSH BC LD HL,SOURCE ADD. LO OE,DESTINATION ADD LO BC,NUMBER OF BYTES LDIR POP BC POP DE POP HL RET	E5 OE C5 21 XX XX 11 XX XX 01 XX XX ED B0 C1 D1 E1 C9
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You must replace the XXX's with the relevant data. All data must appear with the least significant byte first :-

E.g. to move 0020H bytes of data
from add 1234H to add F010
HL=3412
OE=10F0
BC=2000

Best of luck PV

HEX OUMP 1: BREAKOUT

This program has a few "holes" in it as you will find out. But I thought it would give you some fun. Its author will let me have an updated version when he sorts it out. It runs from location 1000H and is a simple version of the game BREAKOUT. Use < and > to move the paddle left and right.

```
1000 C3 1F 10 BC F2 51 90 9B F0 1F 00 00 2E 06 F2 1F
1010 00 21 00 0F FF E1 FF FF FF 01 00 E0 FF 20 00 21
1020 00 F0 11 01 F0 01 00 04 36 20 E0 B0 21 00 F0 11
1030 B0 00 19 01 B0 A0 36 7F 23 10 FB 21 00 F0 06 1E
1040 71 23 10 FC 36 B0 23 71 23 11 1F 00 06 17 71 19
1050 71 23 10 FA 06 14 36 2E 23 10 FB 11 F0 FE 19 22
1060 00 10 21 00 30 22 0B 10 2A 00 10 23 22 00 10 22
1070 07 10 36 4F 21 E1 FF 22 09 10 3A 0C 10 3D CB 32

1080 0C 10 21 00 F0 11 A1 02 19 36 00 3E 03 23 77 23
1090 77 23 77 22 03 10 23 77 23 77 06 18 23 36 20 10
10A0 FB 21 00 00 1B 03 2A 0B 10 2B 7C B5 20 FB 04 CB
10B0 40 20 65 2A 07 10 36 20 E0 5B 09 10 19 7E FE 2E
10C0 2B A6 4F FE 7F 28 06 FE 20 28 02 1B 05 36 4F 22
1000 07 10 FE 20 28 42 E5 2A 05 10 E0 5F 5F 29 29 09
10E0 29 29 29 19 22 05 10 7C E6 0E 21 0F 10 B5 6F 30
10F0 01 24 5E 23 56 E0 53 09 10 E1 79 FE 7F 20 B4 21

1100 00 F0 11 1E 00 19 7E FE 80 20 02 3E B0 3C FE BA
1110 20 05 36 B0 2B 18 EF 77 0B 40 CB 7F F5 FE BC 20
1120 17 2A 03 10 2B 2B 2B 7E FE 80 2B 29 36 03 23 23
1130 22 03 10 23 23 23 36 20 F1 FE BE 20 19 2A 03 10
1140 23 23 23 7E FE B0 2B 0E 36 03 2B 2B 22 03 10 2B
1150 2B 2B 36 20 E5 E1 C3 A6 10
```

HEX DUMP 2. ASM 32

You lucky people, two HEX DUMPS in one issue. This Dump may look like a job and a half to enter, but believe me it's worth it. The program is that of an EDITOR ASSEMBLER; I call it ASM 32 - standing for ASSEMBLER for a 32 character line screen.

The program resides at locations 1000H to 1FFFH and starts its source file at 3000H.

When run from address 1000H the prompt C> is seen; this signifies that you must enter one of the following command letters:

A Assemble option E to printer. V screen. Return ass.to memory
B goto Bottom of file.
O move to next line Down.
E Erase file ie. start new file.
F Find string. FLD HL finds first appearance of string LO HL
I Insert line.
K Kill line.
M print Memory used.
N replace existing line with New line.
Pn Print n lines to screen.
R Read next file from tape.
S Symbols tables option V video. E printer.
T goto Top of file.
U move to next line Up.
W Write file to tape. (MESSAge)
Z exit to ZYMON.

The following are legal entries also:

END assembly. DS nn. allocate nn bytes. OW nn define word nn
DB n define byte n. s:EQU nn s equates to byte or word nn. ORG
nn Origin set to address nn. LOAD nn load objective code to nn
; allows remark to be made. Arithmetic operators are allowed
eg LO HL,SCREEN+20. All numbers are decimal unless an H is
tagged on to the end eg. 1000H. Numbers having letters as
the m.s.b. must have a leading Zero eg. 0FFFFH.

Error Messages. OBL:SYMBOL same symbol used more than once.
UNDEF : undefined symbol used. SYMBOL: left out. RSVD: reserved
word used. FULL : symbol table full. EOF: no ENO statement.
ERR: error found. OPNO: error in operand.

Next issue I'll start a series on how to use the Assembler.

Best of luck with this worthwhile project.

P.V

ASM 32

```

1000 C3 CE 10 43 BE 45 52 52 BF 45 4F C6 4F 50 54 49
1010 4F 4E BE 40 53 47 BE 52 53 56 C4 46 55 4C CC 44
1020 42 4C 2E 53 59 4D 42 4F CC 4F 50 4E C4 55 4E 44
1030 45 C6 4F 52 C7 40 45 C0 45 52 52 4F 52 53 20 44
1040 45 54 45 43 54 45 44 B0 5A 00 41 44 20 30 46 30
1050 38 30 48 00 32 00 65 21 20 F0 36 5F 11 21 F0 01
1060 20 00 E0 B0 21 00 70 00 00 20 20 20 33 20 00 00
1070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

1080 FF FF FF FF FF FF 62 1A 62 1A 62 1A 62 1A 62 1A
1090 1F 00 56 1A C1 19 0B 19 62 1A 43 1B 02 14 49 10
10A0 5C 13 0A 11 12 11 87 11 88 11 0A 10 56 09 01 01
10B0 03 00 00 00 01 00 00 30 21 30 00 30 00 30 47 1F
10C0 AA 10 4C 1F 01 10 81 F0 00 00 00 10 E0 F2 00 21
10D0 AC 10 00 F9 C0 55 11 C0 CB 14 21 0A 10 E5 E0 73
10E0 C0 10 00 36 00 56 2E 03 C0 82 14 00 CA CB 14 FE
10F0 53 CA F4 12 EB 2A B6 10 FE 46 28 1E E5 05 C5 0E

1100 01 11 48 10 21 57 13 C0 08 18 0A F8 14 C1 E3 C0
1110 EC 14 78 B1 20 01 03 E1 E3 C9 00 CA F8 14 C5 C0
1120 90 15 C1 2B E5 E1 7E 23 FE 00 CC E9 15 C0 82 13
1130 41 11 49 10 E5 1A BE 20 EC 13 23 10 F8 E1 C0 A0
1140 11 18 20 C0 A3 11 30 28 0B 78 B1 20 F6 18 21 2A
1150 BA 10 22 BC 10 21 01 00 22 B4 10 2A BA 10 22 B6
1160 10 C9 0B C5 C0 90 15 C1 C0 E9 15 0B 78 B1 20 F3
1170 C0 82 13 C0 9E 15 C3 A2 13 E5 C5 C0 00 14 C1 E1

1180 0B 78 B1 20 F4 18 E9 C7 2E 23 E0 7B C0 10 C0 94
1190 13 2A B8 10 01 01 00 C0 70 11 23 C0 E9 15 0B 78
11A0 B1 20 F4 E5 2A B4 10 2B 22 B4 10 E1 2B C0 3E 15
11B0 30 A3 2B 7E FE 00 20 F5 23 22 B6 10 37 C9 C0 9E
11C0 15 EB C0 85 14 FE 2E C8 C0 0C 11 EB C0 E9 15 18
11D0 E0 E5 CD 00 14 C0 9E 15 C0 85 14 01 05 C5 2A BC
11E0 10 E5 09 0C 00 79 77 BE 2B 20 F9 23 22 BC 10 E3
11F0 E5 E0 52 E3 C1 D1 03 E0 B8 C1 01 B7 CA 9B 12 B9

1200 4F 21 48 10 E0 B0 C8 1B 3E 00 12 C3 9B 12 2E 13
1210 C0 82 14 06 40 AF C0 30 14 10 FB 3E FF C0 30 14
1220 11 48 10 1A CD 30 14 C0 B7 13 13 FE 00 20 F4 06
1230 40 2A BC 10 3E FF 77 23 10 FC 2A BA 10 0E 00 7E
1240 FE FF 28 1E C0 30 14 C0 B7 13 FE 00 28 05 B1 4F
1250 23 18 EC 79 C0 30 14 06 05 AF C0 30 14 10 FB 23
1260 18 0B 06 20 C0 30 14 10 FB C9 06 20 CD 4C 14 B7
1270 20 F8 1D F8 CD 4C 14 FE FF 20 F9 C0 4C 14 C0 B7

1280 13 FE 00 20 F6 2A BC 10 11 00 00 0E 00 CD 4C 14
1290 B7 28 FA FE FF 28 36 77 BE 28 0A 2E 35 3E 00 CD
12A0 B7 13 C3 90 13 CD B7 13 FE 0D 28 05 81 4F 23 18
12B0 0C C0 4C 14 B9 23 2B D3 13 06 04 3E 2A 77 BE 20
12C0 0A 23 10 F9 3E 00 77 BE 20 01 23 1B BE 22 BC 10
12D0 2B 36 00 7A B3 28 09 2E 38 C0 73 14 EB C0 CB 15
12E0 3E 00 C0 B7 13 2A BA 10 C0 CB 15 2A BC 10 C0 00
12F0 15 C3 A5 13 21 A5 13 E5 3A 49 10 F5 C0 62 16 00

```

ASM 32

13DD	36	D2	D1	F1	4F	FE	DD	20	DC	DE	41	CD	15	13	DC	79
131D	FE	5B	2D	F7	C9	21	45	1F	23	23	7E	3C	C8	D6	DD	54
132D	5D	D4	CB	7E	23	28	FA	1A	B9	2D	ED	DD	35	D2	2D	DE
133D	CD	A5	13	DD	36	D2	D2	D5	C5	CD	B3	14	C1	D1	EB	D5
134D	5D	3E	08	CD	B8	17	E1	5E	23	56	EB	CD	CB	15	CD	9A
135D	13	CD	9A	13	EB	18	C2	D5	43	11	DA	87	11	D2	6A	12
136D	D7	DE	12	C1	F6	15	C5	4F	11	CD	E5	12	C9	BE	11	D4
137D	55	11	CE	D1	11	C2	62	11	C4	63	11	CB	79	11	DD	97
138D	11	FF	D5	EB	2A	BC	1D	2B	B7	ED	52	EB	D1	DD	2E	D9
139D	ED	7B	CD	10	DD	36	DD	56	18	D6	3E	2D	18	D9	2E	48
13AD	26	1D	CD	75	14	3E	DD	DD	CB	DD	4E	CA	55	14	DD	CB
13BD	DD	56	CA	3D	14	CB	BF	F5	C5	D5	E5	FE	OC	2D	1D	CD
13CD	19	14	21	ED	F2	36	5F	22	CC	1D	E1	D1	C1	F1	C9	2A
13DD	CC	1D	36	20	FE	7F	2D	08	2B	7D	FE	DF	2D	E7	18	E2
13ED	FE	DD	28	12	77	23	7C	FE	F3	2D	DA	CD	DD	14	21	ED
13FD	F2	CD	04	14	18	CC	CD	D4	14	CD	DD	14	21	ED	F2	CD
14DD	D4	14	18	BE	36	2D	23	7D	E6	1F	2D	F8	C9	21	2D	FD
141D	11	DD	FD	D1	ED	D2	ED	BD	C9	21	DD	FD	11	D1	FD	D1
142D	DD	D3	36	2D	ED	BD	C9	CD	2D	14	28	FB	C9	D5	16	DD
143D	DB	4D	C6	8D	3D	D3	57	18	F7	7A	B7	D1	C9	F5	DB	D4
144D	CB	7F	28	FA	F1	D3	D5	F5	F1	F5	F1	C9	DB	D4	CB	77
145D	28	FA	DB	D5	C9	CB	BF	F5	C5	DE	06	ED	4D	CB	68	2D
146D	DD	CB	78	28	F4	DC	ED	79	FE	DD	3E	DA	28	EB	C1	F1
147D	C3	B5	13	26	1D	7E	FE	0D	C8	CD	A7	13	CB	7E	23	28
148D	F4	C9	CD	73	14	21	48	1D	D1	DD	DD	CD	27	14	77	FE
149D	7F	2D	D7	DD	FA	85	14	2B	18	14	FE	0D	2D	08	DC	CD
14AD	A5	13	3A	48	1D	C9	79	FE	3B	28	ED	7E	DC	23	CD	A7
14BD	13	18	D8	DD	35	D3	CD	3E	DB	DD	C8	DD	4E	2D	D2	3E
14CD	3C	DD	77	D3	CD	49	15	DC	27	14	C9	3E	DC	C3	A7	13
14DD	E5	CD	90	15	E5	2A	BC	1D	E5	B7	ED	42	22	BC	1D	E1
14ED	D1	D5	B7	ED	52	E3	C1	D1	C8	ED	BD	C9	11	49	1D	DD
14FD	C8	41	CD	FD	14	44	4D	DD	2E	D5	C3	9D	13	2B	7E	OE
15DD	1D	FE	48	28	D9	DE	D8	FE	4F	28	D3	DE	DA	D4	D5	21
151D	DD	0D	1A	D6	3D	FE	DA	38	D5	D6	D7	FE	DA	D8	B9	3F
152D	D8	D5	5D	54	CB	49	2D	D8	11	DD	DD	CB	59	2D	01	29
153D	29	29	19	29	5F	16	DD	19	D1	D8	13	1D	D5	C9	D5	EB
154D	2A	BA	1D	B7	ED	52	EB	D1	C9	CD	69	15	11	10	27	42
155D	DB	4D	C6	8D	3B	DB	1D	F8	1B	7A	B3	2D	F2	C9	DB	40
156D	C6	8D	38	FA	CD	7D	15	37	C9	F5	C5	D5	E5	21	86	15
157D	11	FA	F2	D1	D5	DD	ED	BD	E1	D1	C1	F1	C9	F5	C5	D5
158D	E5	21	8B	15	18	EA	44	45	4C	41	59	5D	41	55	53	45
159D	CD	82	13	D1	DD	DD	7E	23	D3	FE	DD	2D	F9	C9	E5	C5
15AD	21	69	1D	E5	D6	D5	36	2D	23	1D	FB	36	DD	EB	1B	D1
15BD	DA	DD	2A	B4	1D	1B	D5	EB	CD	8F	19	7B	D1	C6	3D	12
15CD	7D	B4	2D	F1	E1	CD	75	14	C1	E1	C9	E5	21	9A	13	E3
15DD	7C	CD	D5	15	7D	F5	DF	DF	DF	DF	CD	DE	15	F1	E6	OF
15ED	C6	9D	27	CE	4D	27	C3	A7	13	22	B6	1D	E5	2A	B4	1D
15FD	23	22	B4	1D	E1	C9	CD	62	16	DD	C4	EC	14	ED	43	C8

ASM 32

16D0 10 21 47 1F 36 FF 22 BE 10 CD 10 16 DD CB 00 AE
 1610 CD 55 11 DD 36 02 00 2A B6 10 22 B8 10 2A C4 1D
 1620 E5 21 00 00 DD 75 01 22 B0 10 CD 53 1A FE 31 CC
 1630 71 16 FE 0B 28 19 FE 30 20 23 CD EA 17 38 1E DD
 1640 71 04 CD CC 16 C2 52 18 CD E4 18 FE 0B 20 0E E1
 1650 CD 23 18 DC 48 17 CD EC 15 04 20 BB C9 2E 05 C3
 1660 8A 11 2E 0C CD 82 14 F6 B8 DD 77 00 DD 36 03 01
 1670 C9 DD CB 01 CE 0C DD 71 05 0D CA 88 11 CD DC 17

1680 30 45 CD EA 17 30 40 CD D7 17 FD 22 C2 10 DD CB
 1690 00 6E 28 30 2E 1F D2 8A 11 2A BE 10 E5 06 00 09
 16A0 23 23 23 CD 3E 15 2E 1B DA 8A 11 E1 EB ED B0 EB
 16B0 2B CB FE C1 D1 D5 C5 23 73 23 72 22 C2 10 23 36
 16C0 FF 22 BE 10 C3 53 1A 2E 17 C3 8A 11 44 CB 7D 20
 16D0 D4 DD CB 01 DE CB BD 5D 16 00 7D 21 0E 17 19 5E
 16E0 23 56 D5 FE 05 D8 FE 27 DA E4 18 CD E4 18 E5 F5
 16F0 CD E4 18 4F F1 EB E1 07 07 07 07 B1 4F FD E1 CD

1700 04 1A 47 28 01 EB 7D 07 07 07 07 B3 FD E9 6E 18
 1710 CA 1B 43 1B 35 1C 42 1C 77 1C C0 1A CE 1A A3 1C
 1720 03 1D 3A 1D 28 1D ED 1A F3 1A 10 1B 66 1B 32 1B
 1730 8F 1C D8 1C 26 1B 75 1B 61 1C 4C 1C 78 1D 53 1D
 1740 CB 1C BD 1C C4 1C 5D 1D C5 DD 4E D2 ED 5B B0 10
 1750 FD 21 48 10 D5 CD B3 14 CD 9E 15 D1 D6 DE 0C 0D
 1760 28 17 CD CB 15 06 D4 FD 7E 00 CD D5 15 FD 23 23
 1770 0D 28 D3 10 F2 D4 CB 20 05 CD 9A 13 10 FB E5 2A

1780 B8 10 DD CB 01 46 2B 20 3E D8 CD B8 17 53 3E 05
 1790 CD B8 17 5A E5 7E FE 0D 28 08 FE 3B 28 04 14 23
 17A0 18 F3 E1 3E D7 CD B8 17 CD A2 13 22 B8 10 E1 0C
 17B0 DD 20 A1 DD 71 D2 C1 C9 14 92 F5 15 28 07 7E CD
 17C0 A7 13 23 18 F6 F1 38 07 3C 47 CD 9A 13 10 FB 7E
 17D0 23 FE 2D 28 FA 2B C9 21 47 1F 18 2C 21 99 1D DD
 17E0 CB 01 5E 28 23 21 B5 1D 18 1E 21 ED 1D C5 0E 01
 17F0 CD 0B 18 C1 23 38 11 13 0D 37 C4 D8 18 03 1B C9

18D0 CB 7E 23 28 FB 23 23 D1 7E 3C 37 C8 D5 41 1A 10
 1810 D2 CB FF 04 BE 20 E9 13 23 10 F3 5E 23 56 E3 EB
 182D FD E1 C9 DD 7E 0D EE 2D CB 6F C8 CB 77 C8 37 CB
 1830 47 C8 CB 4F C8 B7 C9 FE 03 2D 17 DD 7E D1 CB 67
 1840 C2 EF 19 CB 4F C9 FE D3 2D 08 DD CB 0D 6E C0 7C
 1850 B7 C8 2E 29 C3 8A 11 5D CB 5B 20 F6 7B 07 07 D7
 1860 BD 18 0C 3E ED 18 08 7D CD 6F 18 7C 18 01 78 E5
 187D C5 4F DD 46 D2 CD 63 1A 04 10 03 22 CA 1D 23 22

1880 C4 1D DD CB DD 66 20 08 2A C6 10 71 23 22 C6 10
 1890 21 48 10 7D 80 6F 71 78 3C DD 77 02 FE 20 2D 08
 18A0 CD 23 18 20 09 DD 35 02 C1 E1 AF C9 E5 C5 DD 46
 18B0 02 2A CA 10 3E 3A CD A7 13 78 CD D5 15 CD D0 15
 18C0 7D 84 80 4F AF CD D5 15 21 48 10 7E 81 4F 7E CD
 18D0 D5 15 23 10 F6 DD 70 02 AF 91 CD D5 15 CD A5 13
 18E0 C1 E1 AF C9 DD CB D1 46 3E 0B C0 C5 CD F1 18 C1
 1BF0 C9 CD BE 19 D8 FE 34 D6 00 2D D5 CD BE 19 06 04

ASM 32

1900 FE 32 2D 31 7C 8D 57 E5 CD BE 19 E1 4F 7A D8 FE
 1910 D6 20 2F CB 71 28 2B 45 C5 CD BE 19 CD 45 19 C1
 1920 CD 4A 18 20 0C 7D CB 79 28 03 ED 44 6F A9 FA 52
 1930 18 60 3E DA C9 FE 36 20 0C B0 6F E5 CD BE 19 E1
 1940 7D D8 C3 52 18 FE 03 2D F9 B0 F5 E5 CD BE 19 E1
 1950 38 11 F5 E5 CD BE 19 EB E1 FE 03 20 E5 F1 CD 65
 1960 19 18 E8 F1 C9 FE 40 20 D2 19 C9 FE C0 20 03 ED
 197D 52 C9 FE 82 20 07 7B A5 6F 7A A4 67 C9 FE 83 2D

1980 07 7B B5 6F 7A B4 67 C9 4B 42 EB FE 81 20 18 21
 1990 00 00 3E 11 B7 ED 6A ED 42 30 02 09 37 3F CB 13
 19A0 CB 12 3D 2D F0 EB C9 FE 80 20 97 21 00 00 3E 10
 19B0 CB 38 CB 19 3D 01 19 EB 29 EB 3D 20 F3 C9 CD 53
 19C0 1A FE 31 CA 52 18 FE 0B 20 06 DD CB D1 C6 37 C9
 19D0 FE 33 37 C8 FE 30 37 3F C0 CD DC 17 3E 32 D0 CD
 19ED D7 17 3E 03 D0 3F DD CB 01 E6 DD CB 00 6E C0 2E
 19F0 2D C3 8A 11 2A B6 10 CD 82 13 23 22 B6 10 2B 7E

1A00 FD 21 22 1A D5 FD E5 E3 5E 53 23 BE 28 03 15 20
 1A10 F9 16 00 19 7E 19 5F 7E CB 7B CB BB 19 E3 FD E1
 1A20 D1 C9 10 0D 27 24 2A 2F 2B 2D 26 2E 28 29 3B 3A
 1A30 22 2C 00 1F 2C 1E 1C 1B 1A 19 18 17 16 06 0D 13
 1A40 20 11 3B 0B 00 03 80 81 40 C0 82 83 34 00 00 31
 1A50 00 33 35 CD F4 19 01 00 21 FD E9 CD F4 19 FE 0B
 1A60 20 F9 C9 2A C4 10 DD CB 00 7E C8 2E 32 C3 8A 11
 1A70 E5 46 5E 0C CD F4 19 FE 0B 28 2C 7E B8 20 F3 EB

1A80 D1 0D 28 23 61 3E 03 25 C8 24 3E 36 C9 7E B8 38
 1A90 C2 FE 30 38 15 FE 3A 30 11 CD AA 1A FE 31 28 07
 1AA0 41 CD FD 14 3E 03 D0 C3 52 18 EB 0C CD F4 19 FE
 1AB0 31 C8 FE 35 20 04 7E B8 30 F1 22 B6 10 3E 30 C9
 1AC0 FE 09 20 0A 7D E6 E7 C0 45 CB E8 CD E4 18 FE 03
 1AD0 C0 CD 6E 18 DD CB 00 6E 20 0F ED 5B C4 10 37 ED
 1AE0 52 7C 24 28 02 25 C0 AD F8 7D C3 6F 18 FE 03 C0
 1AFD C3 67 18 FE 36 2D 0A 13 1A CD 6F 18 25 20 F8 18

1B00 07 CD 46 18 7D CD 6F 18 CD E4 18 FE 0B 20 E4 C9
 1B10 CD 37 18 CD 43 1B EB 2A C4 10 19 22 C4 10 2A C6
 1B20 10 19 22 C6 1D C9 CD 37 18 22 C6 10 DD CB 00 A6
 1B30 AF C9 CD 37 18 22 C4 1D DD CB 00 E6 DD CB 00 BE
 1B40 C4 6C 1B CD 23 18 C8 DD 7E 02 B7 C4 AC 18 78 B7
 1B50 C8 3E 3A CD A7 13 AF CD D5 15 2A C8 10 CD D0 15
 1B60 AF CD D5 15 AF C9 CD 37 18 CA 88 11 EB 2A C2 10
 1B70 72 2B 73 AF C9 15 53 03 80 08 00 11 72 27 23 70

1B80 D7 71 17 12 A3 13 A0 DA 50 05 00 95 98 21 A0 AC
 1B90 31 35 B4 B3 3C BB 41 C0 D1 D7 DE 62 E1 69 E8 35
 1BA0 16 06 47 57 4D F9 22 2A 21 32 3A 22 2A F9 36 01
 1BB0 02 0A D2 0A D0 7B FE 04 C0 CD 4A 18 CD 58 1B 7D
 1BC0 C3 6F 18 CB 53 28 22 7D B0 47 CD 63 18 C3 6E 18
 1BD0 7D BD 47 C3 58 18 FE 64 CD 18 F2 7B CD 6F 18 CD
 1BED 6E 18 C3 67 18 CB 53 20 F6 C3 52 18 7B FE 04 28
 1BF0 EE CD 63 18 78 EE 61 47 CD 58 18 C3 67 18 7B FE

ASM 32

1C00 06 C0 60 18 DD CD 4A 18 7A 65 6B 1B CF C0 58 18
 1C10 18 D0 C0 6B 18 CD 29 1C 7D 18 A5 FE 07 28 AE CB
 1C20 E0 FE 27 28 A8 7D FE 04 C0 CB 58 06 46 C2 58 18
 1C30 7B F6 70 18 8B CD 46 18 20 03 7D A0 C0 78 B5 C3
 1C40 6F 18 FE 09 28 F7 06 C9 FE 0B 18 11 03 68 5B 00
 1C50 03 06 10 E9 E9 C3 60 C3 67 18 7D FE 04 C0 C3 6E
 1C60 18 01 00 01 C0 79 FE 38 CA 0F 1B FE 93 C0 78 E6
 1C70 C6 B5 47 EB C3 DF 18 FE 01 20 0B 7D FE 06 CA 52

1C80 18 CB 90 C3 57 18 FE 02 C0 CB E8 60 C3 67 18 CD
 1C90 46 18 20 04 3E 02 95 D8 11 A0 1C 19 46 C3 CA 18
 1CA0 46 56 5E FE 02 28 E2 FE 01 CA 57 18 CB 58 06 34
 1C80 28 01 04 87 20 5B 78 E6 C7 47 C3 57 18 02 11 00
 1CC0 17 B4 4A 8E 02 11 00 10 AD 42 9E 04 11 21 22 00
 1CD0 08 0E 1A A0 09 09 29 B6 5D C0 63 18 7D FE 04 C0
 1CE0 C3 58 18 7B FE 04 CA 52 18 70 CD 6F 18 C3 58 18
 1CF0 7B 80 60 C0 C3 67 18 79 E6 F0 C0 C8 53 CA 52 18

1D00 79 E6 0F FE 03 20 0A CB F0 CD 4A 18 65 68 C3 67
 1D10 18 FE 0A 20 05 CD 6B 18 18 F2 FE 05 CA 5A 1C B7
 1D20 C0 78 E6 F8 B5 C3 6F 18 CD 46 18 20 04 3E 07 95
 1D30 D8 70 07 07 07 B0 47 CD E4 1B FE 0A 20 0C E5 6C
 1D40 26 CB CD 67 18 E1 60 C3 67 18 F5 3E CB CD 6F 18
 1D50 F1 18 C7 03 07 04 00 8D 93 19 08 40 00 03 70 40
 1D60 00 03 09 0F D3 41 00 CB 53 28 0A C3 09 1D C0 63
 1D70 18 2D CA 58 18 C3 52 18 04 11 51 52 00 04 11 93

1D80 0D EB E3 E3 00 FE 24 CA 6E 18 06 08 FE EE CA 6E
 1D90 18 18 E2 C3 D6 1B C3 FE 1B C3 18 09 4E C3 10 09
 1DA0 0A 08 09 4E DA 00 09 D0 30 09 CD 38 09 50 CF 20
 1DB0 09 50 C5 28 09 48 CC 04 01 44 C5 02 01 42 C3 00
 1DC0 01 41 C6 0E 01 53 D0 06 01 C1 07 00 C2 00 00 C3
 1DD0 01 00 C4 02 00 C5 03 00 C8 04 00 CC 05 00 C9 00
 1DE0 08 02 08 08 49 D9 FD 02 49 D8 D0 02 FF CC 42 1E
 1DF0 C3 5D 1E C4 80 1E C9 9A 1E D3 87 1E CF D4 1E C5

1E00 F4 1E D2 07 1F FF 4A D0 AC 00 4A D2 8C 18 50 55
 1E10 53 C8 0A C5 50 4F D0 0A C1 41 44 C4 32 00 41 44
 1E20 C3 34 00 42 49 D4 16 46 58 4F D2 12 AE 41 4E C4
 1E30 12 A6 4E 4F D0 00 00 4E 45 C7 02 44 48 41 4C D4
 1E40 00 76 FF C4 28 00 4F 41 C4 26 00 44 C9 02 A0 44
 1E50 49 D2 02 B0 44 C4 02 A8 44 44 D2 02 B8 FF 41 4C
 1E60 CC AA 00 D0 12 BE 43 C6 00 3F 50 CC 00 2F 50 C9
 1E70 02 A1 50 49 D2 02 B1 50 C4 02 A9 50 44 02 02 B9

1E80 FF 45 C3 10 0B 4A 4E DA 0E 10 C2 1A 00 D7 18 00
 1E90 D3 1C 00 41 C1 00 27 C9 00 F3 FF 4E C3 10 03 C0
 1EA0 22 00 CE 30 00 4E C9 02 A2 4E 49 02 02 B2 4E C4
 1EB0 02 AA 4E 44 D2 02 BA FF 42 C3 36 00 43 C6 00 37
 1EC0 4C C1 14 26 52 C1 14 2E 52 CC 14 3E 45 D4 16 C6
 1ED0 55 C2 12 96 FF D2 12 B6 52 C7 20 00 55 D4 38 00
 1EE0 55 54 C9 02 A3 54 49 D2 02 B3 55 54 C4 02 AB 54
 1EF0 44 D2 02 BB FF D8 2E 00 58 D8 00 D9 51 D5 1E 00

ASM 32

```

1F00 C9 00 FB 4E C4 04 FF FF 45 04 88 C0 53 04 06 C7
1F10 45 03 16 86 CC 14 16 4C C3 14 06 4C 43 C1 00 07
1F20 4C C1 00 17 02 14 1E 52 C3 14 0E 52 43 C1 00 0F
1F30 52 C1 00 1F 4C C4 24 6F 52 C4 24 67 45 54 C9 02
1F40 40 45 54 CE 02 45 FF FF 53 04 06 00 50 00 07 00
1F50 40 41 02 08 00 40 41 52 C7 40 00 40 4F CE 66 00
1F60 4C 49 4E C5 40 00 40 45 53 CC 00 F0 54 45 58 54
1F70 CC 00 20 4B 42 00 40 00 56 44 05 40 F0 56 44 55

1F80 03 C0 02 56 44 55 C5 FF F2 4C 49 4E 45 C5 60 F2
1F90 54 45 58 54 C0 00 70 4B C0 40 00 48 43 C3 03 00
1FA0 4B 52 02 12 00 43 52 02 00 00 4B C3 43 00 48 C4
1F80 44 00 48 08 58 00 4B C5 45 00 4B 02 52 00 43 C1
1FC0 01 00 43 46 C6 06 00 03 53 00 43 50 00 10 00 43
1F00 43 02 00 00 43 4C C6 0A 00 52 C5 FF 00 43 CB 08
1FE0 00 4B 45 C2 42 00 4C C6 0A 00 42 03 08 00 44 45
1FF0 CC 07 00 43 05 05 00 43 C4 18 00 43 02 04 00 43

```

BITS OF BASIC [2]

Simulating Arrays.

ZY8ASIC V2.03 has only one array. It is single dimensioned and is accessed by :-

@ (some number)

The "some number" can also be an expression or a variable name. So these are legal :-

```

@ (3+4)
@ (A)
@ (A+8)

```

If I need two single dimensioned arrays I can simulate them by using displacement indexing :-

```

10 A=0
20 B=100
30 @(A+3)=6
40 @(B+3)=6

```

Here the third item in each array has been set to the value 6.

To be even more flexible I should specify my index as a variable. So using Y as my index gives :-

```

10 A=0
20 B=100
30 Y=3
40 GOSUB 1000
99 STOP

1000 X=1
1010 IF @(A+Y) <> @(B+Y) X=0
1020 RETURN

```

In the subroutine flag X has been set to zero if both items indexed by Y in the arrays A and B are not equal.

To take this idea one stage further suppose that you need a two dimensioned array of size 5,4:

```

      : 1 : 2 : 3 : 4 : 5 : :
:-----:-----:-----:-----:-----: :
1: 1 : 2 : 3 : 4 : 5 : :
:-----:-----:-----:-----:-----: :
2: 6 : 7 : 8 : 9 : 10 : :
:-----:-----:-----:-----:-----: N
3: 11 : 12 : 13 : 14* : 15 : :
:-----:-----:-----:-----:-----: :
4: 16 : 15 : 18 : 19 : 20 : :
:-----:-----:-----:-----:-----: :
      :-----X-----
      :-----P-----

```

To access position 14 using the horizontal and vertical indices will require an equation to convert both indices to the real position :-

Let N be the vertical index required
 Let P be the horizontal index required
 Let X be the horizontal dimension of the array

So in our case X = 5

N = 3

these index item 14

P = 4

Using the expression $N \times X + P - X$ will produce the real index.

So in an example program:

```

10 X=5
20 N=3
30 P=4
40 GOSUB 1000
90 STOP

1000 A=@(N*X+P-X)
1010 RETURN

```

Now A has the value of the two dimensioned array held at index position 4,3.

More than one array can be formed by using the displacement method previously described so :-

```

10 A=0
20 B=100
:
90 GOSUB 1000
:
:
1000 @(B+(N*X+P-X))=Y
1010 RETURN

```

Here the value Y has been placed in the two dimensioned array B indexed by P,N.

To prove the above RUN the following program, which will print a two dimensioned array as indices and real positions.

```

10 X=5
20 P." ! 1 2 3 4 5"
30 P."--!-----"
40 FOR N=1 TO 4
50 P.%1,N,"!",
60 FOR P=1 TO X
70 P.%2,N*X+P-X,
80 NEXT P
90 P.
100 NEXT N

```

Finally can anyone produce the expression for three dimensioned arrays?

Solutions to Pete please.

BYE B.E.

More from Your ZYBASIC.

A number of members have commented on the lack of arithmetic and trigonometrical functions in ZYBASIC. This prompted me to look for some way of providing at least the most common functions. I have therefore listed below four Subroutines, which provide the user with :-

Square Roots (SQR(X)) *(see note at foot of page)
 Exponentiation (X to the Power Y)
 Logarithms (Log X base e & base 10)
 Exponential (EXP (X))

All except the Exponentiation routine may be used independently but the Exponentiation routine uses both the LOG & EXP functions

Square Root.

Gives: SQR (X) = Y (uses W & Z internally)

```

2990 S.
3000 ! SQR (X) = Y
3010 IF X= 0 Y=0:RET.
3020 IF X>0 G.3040
3030 P."Root of NEG Number!":S.
3040 Y=X*.5:Z=0
3050 W=(X/Y-Y)*.5
3060 IF (W=0)+(W=Z) RET.
3070 Y=Y+W:Z=W:G.3050

```

When I entered X = 198.32 out popped 14.0826, my Commodore calculator says 14.082613 (not bad !).

Exponentiation.

Gives: $X^Y = P$ (If X is less than zero, Y must be an odd integer
 The routine uses E,L,A,B,C internally. The value of X is changed.
 LOG & EXP routines are required)

```

3100 !  $X^Y = P$ 
3110 P=1:E=0:IF Y = 0 RET.
3120 IF (X<0)*(INT(Y)=Y) P=1-2*Y+4*INT(Y/2):X=-X
3130 IF X<>0 GOS.3200:X=Y*L:GOS.3300
3140 P=P*E:RET.

```

Note line 3130 calls the LOG & EXP routines.

*I have just found out that ZYBASIC already has square roots!

Logarithms (Natural & Common).

Gives: LOG (X) (base e)=L
 LOG (X) (base 10)=X
 uses A,B internally. Value of X is changed.

```

3190 ! LOG(X) base e = L LOG(X) base 10 = X
3200 E=0:IF X<0 P."LOG undefined at ",%I,X:S.
3210 A=1:C=0.5
3220 IF X>A X=C*X: E=E+A: G.3220
3230 IF X<C X=X+X: E=E-A: G.3230
3240 X=(X-0.707107)/(X+0.707107): L=X*X
3250 L=((0.598979*L+0.961471)*L+2.88539)*X+E-0.5)*0.693147
3260 IF ABS(L)<1E-6 L=0
3270 X=L*0.4342945:RET
  
```

Using X=4 in the above produced L=1.38629 & X=0.60206 compared with 1.3862943 & 0.6020599 from the calculator.

Exponential.

Gives: EXP(X) = E (uses L & A internally. Value of X changed)

```

3290 ! EXP(X) = E
3300 L=INT(1.4427*X)+1:IF L<127 G.3330
3310 IF X>0 P."Overflow ":S.
3320 E = 0 :RET.
3330 E=0.693147*L-X:A=1.32988E-2-I.41316E-4*E
3340 E=((A-0.166665)*E+0.5)*E-1)*E+1:A=2
3350 IF L<0 A=0.5: L=L-I:IF L=0 RET.
3360 F.X=I TO L: E=A*E: N.X: RET.
  
```

I have tried out all the above and they seem to work OK but if you want to fly your spaceship by them don't ask me to come along.

Next issue I hope to have ArcSine, ArcCosine and ArcTangent. By the way Tangent is easily found as:

$$\text{TAN}(X) = \frac{\text{SIN}(X)}{\text{COS}(X)}$$

If you have any special function routines please let me have them some user could be stuck in space trying to get home all for the lack of your program.

COOE BREAKER.FIVE UNIT COOE

This code is used by British Telecom to signal to their older type of Teleprinter; these can often be picked up by the hobbyist and although quite slow (75 or 100 bd) they are better than no printer at all. Usually they use -80V to +80V to signal; the -80 referred to as a mark and the +80 as a space. In addition to the 5 mark/spaces of the character, start and stop signals have to be provided; the duration of these signals depends on the printer in use.

CHR.LS	CHR.FS	5 UNIT CODE	CHR.LS	CHR.FS	5 UNIT COOE
A	-	0**000*	P	0	00**0**
B	?	0*00***	Q	1	0***0**
C	:	00***0*	R	4	00*0*0*
O	who are you	0*00*0*	S	.	0*0*00*
E	3	0*0000*	T	5	00000**
F	%	0*0**0*	U	7	0***00*
G	@	00*0***	V	=	00*****
H	#	000*0**	W	2	0**00**
I	8	00**00*	X	/	0*0****
J	BELL	0**0*0*	Y	6	0*0*0**
K	(0*****	Z	+	0*000**
L)	00*00**	CARRIAGE RETURN		0000*0*
M	.	000****	FIGURES		0**0***
N	,	000**0*	LETTERS		0*****
O	9	0000***	LINE FEEO		00*000*
		SPACE			000*00*

Key :- * MARKING SIGNAL
F/S Figure shift

0 SPACING SIGNAL
L/S Letter shift

Note lower case is not available in this code. Once Figure or Letter shift has been sent it is remembered by the printer and is only changed by the receipt of the other code.

The list above includes one start and one stop bit. (Start=Mark stop=space).

P.V

Bob Eldridge has asked me to ask users of ZYMON and ZYBASIC what additional facilities they would like to see in these two programs, as he is considering writing a new ZYMON, and may bravely have a go at patching new features into the ZYBASIC. If you have any thoughts on this please drop me a line.

P.V.

VDU 2K

How to turn the VDU K into a 64 by 24 VDU.

(See the page after the diagrams at the end of this article for the VDU-K designer's comments.)

WARNING:

This modification is major. Consider the following points before you begin :-

A 64 by 24 card is not supported by Greenbank. If it fails they cannot be expected to repair it.

Part of the modification involves soldering two 2114 RAM chips together, one above the other. This can destroy them, and you may lose 4 chips.

Many tracks have to be cut, many links have to be installed. Before you begin can you solder with a high level of precision?

At one point you are required to remove a socket, cut a track and put the socket back. With plated through holes this is difficult!, I had to fit a new socket! Have you a desoldering tool?

Still reading? Well it's not that difficult just a little demanding I'd rather you had a good 32 by 24 screen than a mess of a board. Perhaps it would be a good idea to get a second card and have both, Just plug in the size to suit the task and the software.

You need :-

- 2 2114L RAM chips extra to the ones on the board.
- 1 Soldering iron - 1/16 inch tip - 18W should be max.
- 1 Desoldering tool - not braid.
- 1 Pair of cutters.
- Wire for making links - best is wire wrapping type.
- 1 Ballpoint pen - to mark as you proceed.
- 5 Hours of time - average - to complete.
- 1 Interak computer.
- 1 16 pin socket - unless you can salvage the removed one.

I suggest you execute each step and tick it off as you finish. Then you can stop and return later without getting lost.

N) is the reference to figures. i.e.

- 3) Cut track U90 pin 22 - U97 pin 19

Refers you to figure 3 for circuit details.

BEGIN MODIFICATION HERE

- 1) Cut track U14 pin 3 - U14 pin 13 :Non-socket side.
- 1) Add link U14 pin 1 - U14 pin 13 :Non-socket side.
- 1) Add link U8 pin 6 - U8 pin 13 :Non-socket side.
- 1) Cut track U14 pin 3 - U22 pin 7 :Non-socket side.
Ensure U22 pin 7 remains connected to U15 pin 1, best is to cut the track near to U14 pin 3 before it passes through the board.
- 1) Add link U8 pin 12 - U22 pin 7 :Non-socket side.
Link near to U8 just before the through hole that goes to U22 pin 7, and U15 pin 1.
- 4) Find between the 74LS290 U10 and the 74LS393 U11 on the non-chip side of the board, two rows of plated through holes. They are about 1/4 inch apart and are linked together by fine tracking. i.e

```

a0-0u
b0-0v  View on non-socket side
c0-0w
d0-0x  Letters a-z identify the holes 0
e0-0y
0      0z
!
---
--- C6 is on the other side of the board.
! It is shown here to aid location of the links.
0

```

- 4) The above links are shown on the logics as connecting to the 24 row counter, R0 through R4.

Having located the links, cut all 5, so that the two rows of holes are electrically isolated.

```

a0 0u
b0 0v  View as before.
c0 0w
d0 0x
e0 0y
0z

```

Now reconnect the links so that :-

```

a links v
b links w
c links x
d links y
e links z

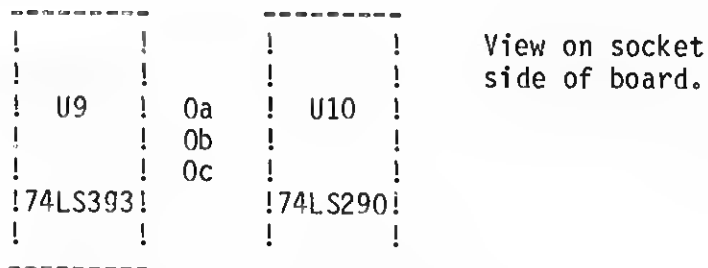
```

At this time u is left unconnected.

3) Locate on the edge connector A10, address bit 10, called AB10. Cut the track feeding the card from A10 near to the edge connector pad.

3) Add link ¹²U13¹² pin 7 - ¹²U13¹² pin 12 :Non-socket side.
Some logic drawings show two U13 chips. The one we need is a 74LS136 and has AB10 connected to pin 12.

4) Between U9 a 74LS393 and U10 a 74LS290 are 3 holes. Reference the logics for U9 pin 11 and pin 10. The line C4 feeding U10 pin 10 must be moved to connect U9 pin 10 to U10 pin 10. This has been designed in by Greenbank and so we need only move the link.



4) Remove link a-b and install link b-c.
(On current cards the link U9 pin 11 - U10 pin 10,(a-b) , is tracked. In those cases you need to cut that track.)

2) Locate chip ¹⁶U16¹⁶ 74LS257(A). So to be sure you are dealing with the correct chip, refer to sheet 5 of the logics, this shows the multiplexers and the RAMs. The chip is the one feeding A9, A8, A7, and CS to the RAMs. It is shown at the top left of the logic diagrams. This chip is known throughout the modification as U16.

2) So having located it remove it from its socket.

Remove the socket, that held ¹⁶U16¹⁶, from the board.

2) Cut track ¹⁶U16¹⁶ pin 11 - ground :On socket side

Replace the socket, for U16, back on the board.

2) Cut track ¹⁶U16¹⁶ pin 8 - U16 pin 11 :Non-socket side.

2) Add link ¹⁶U16¹⁶ pin 9 - U8 pin 11 :Non-socket side.

2) 4) Add link ¹⁶U16¹⁶ pin 11 - U11 pin 11 :Non-socket side..

2) Cut track ¹⁶U16¹⁶ pin 10 - U19 pin 19 :~~Non~~-socket side.

2)3) Add link from A10, (edge connector address bit 10) , to U16 pin 10.

Remove a RAM chip 2114L from its socket.

Take a new RAM chip and bend pin 8 outwards slightly.

Place the new RAM chip over the original one such that the pins coincide, ensure pin 1 is over pin 1, and that pin 8 on the top RAM is not connected to pin 8 on the lower RAM.

Solder the two RAM chips together.

Replace the now 2k RAM into its socket.

Repeat this for the other RAM.

Connect both of the New RAM chips together by the bent out pin 8 in each case.

2) Connect the two new RAM chips, both pin 8's, to U8 pin 10.

That completes the modification, plug in your new card and power up the machine.

The new display, if addressed as F000H, maps to store as :-

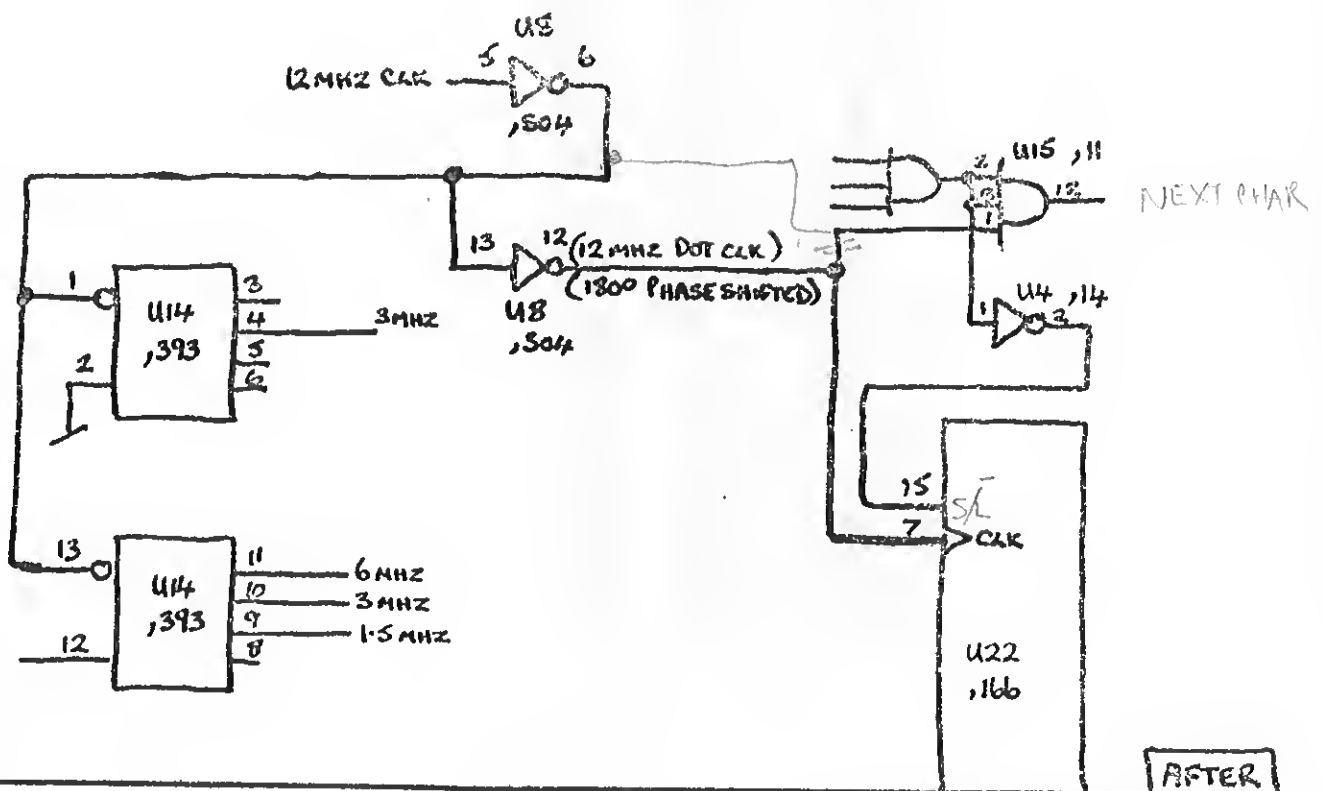
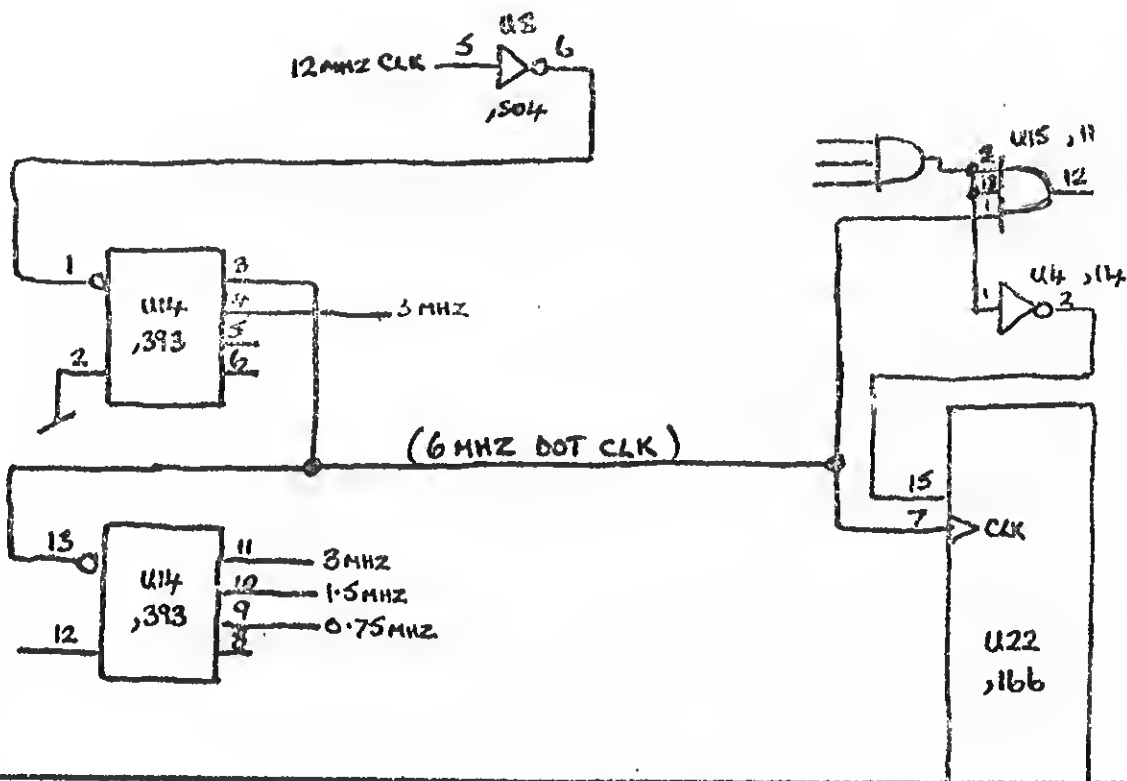
Line 1 is F000 - F03F
Line 2 is F040 - F07F
Line 3 is F080 - F0BF
Line 4 is F0C0 - F0FF
Line 5 is F100 - F13F
Line 6 is F140 - F17F
Line 7 is F180 - F1BF
Line 8 is F1C0 - F1FF
Line 9 is F200 - F23F
Line 10 is F240 - F27F
Line 11 is F280 - F2BF
Line 12 is F2C0 - F2FF
Line 13 is F300 - F33F
Line 14 is F340 - F37F
Line 15 is F380 - F3BF
Line 16 is F3C0 - F3FF
Line 17 is F400 - F43F
Line 18 is F440 - F47F
Line 19 is F480 - F4BF
Line 20 is F4C0 - F4FF
Line 21 is F500 - F53F
Line 22 is F540 - F57F
Line 23 is F580 - F5BF
Line 24 is F5C0 - F5FF

*NB For VDU-2K
in new system
disable reads
U4 pin 13 isolated
from NRAS
and connected to +5V*

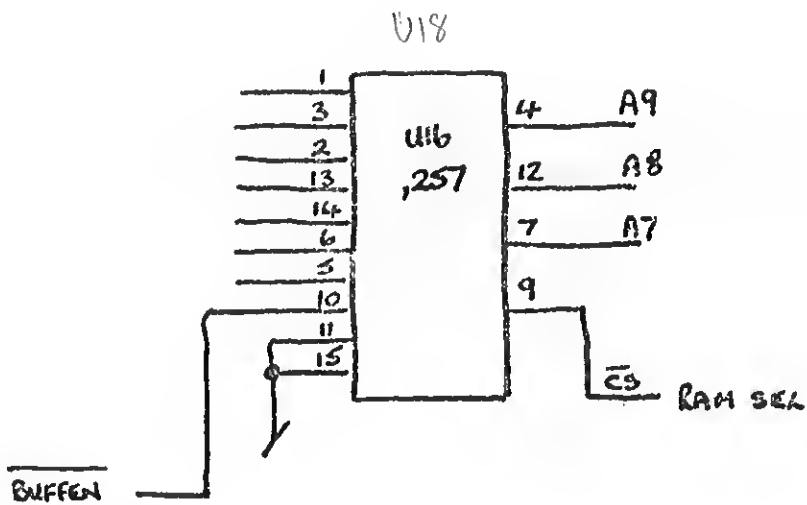
BYE

B.E.

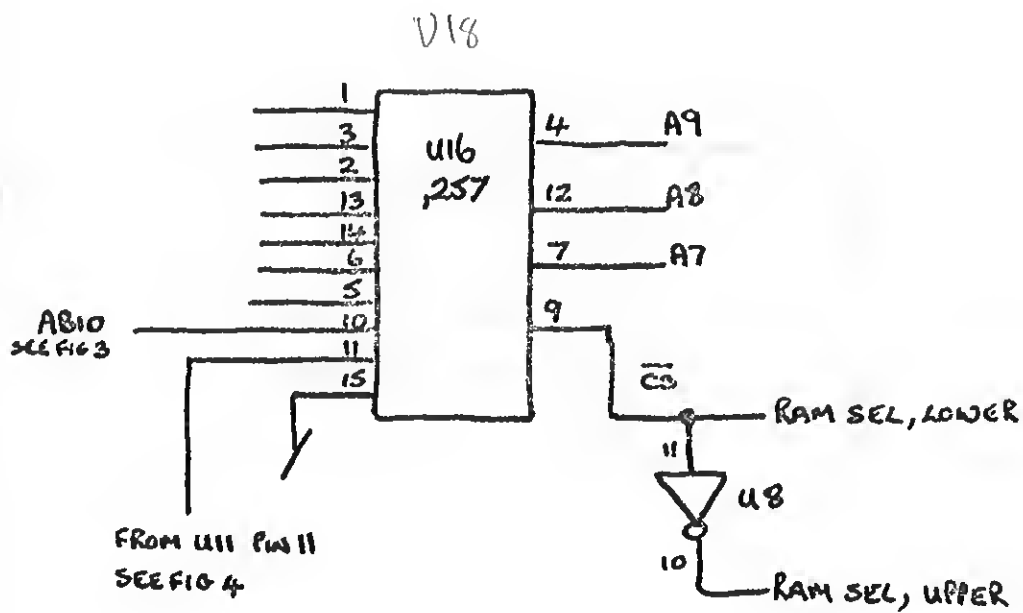
(See the page after the diagrams following for the VOU-K designer's comments.)



VDU 2K FIG 1

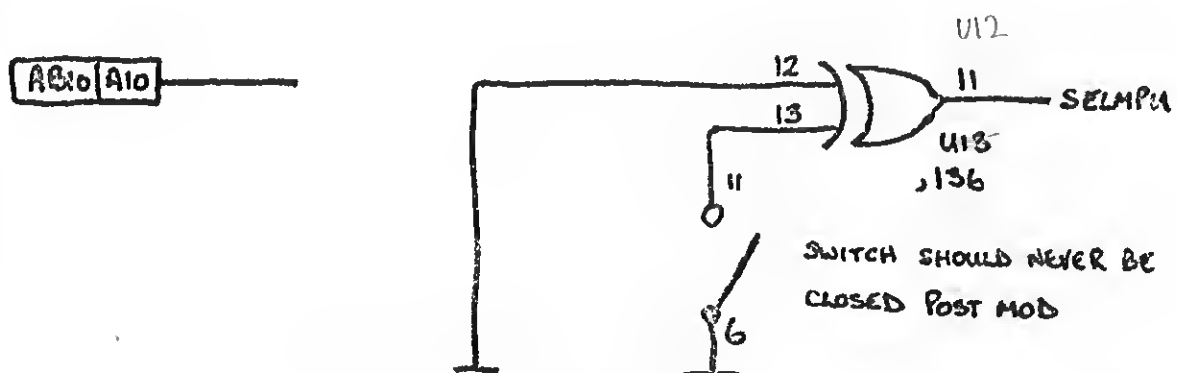
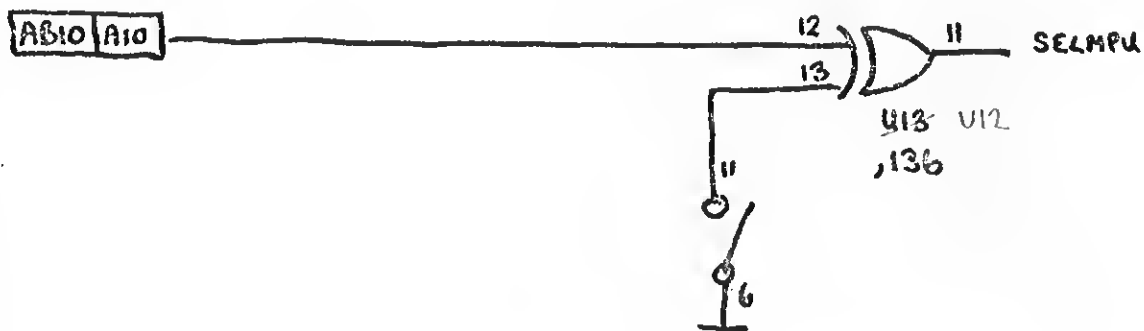


BEFORE

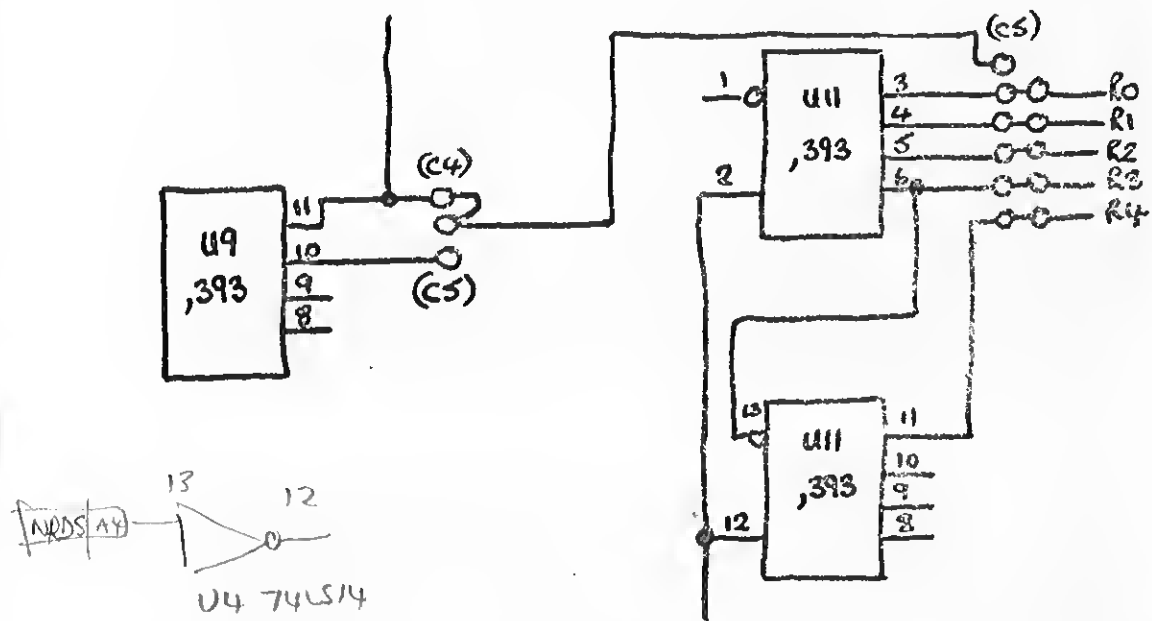


AFTER

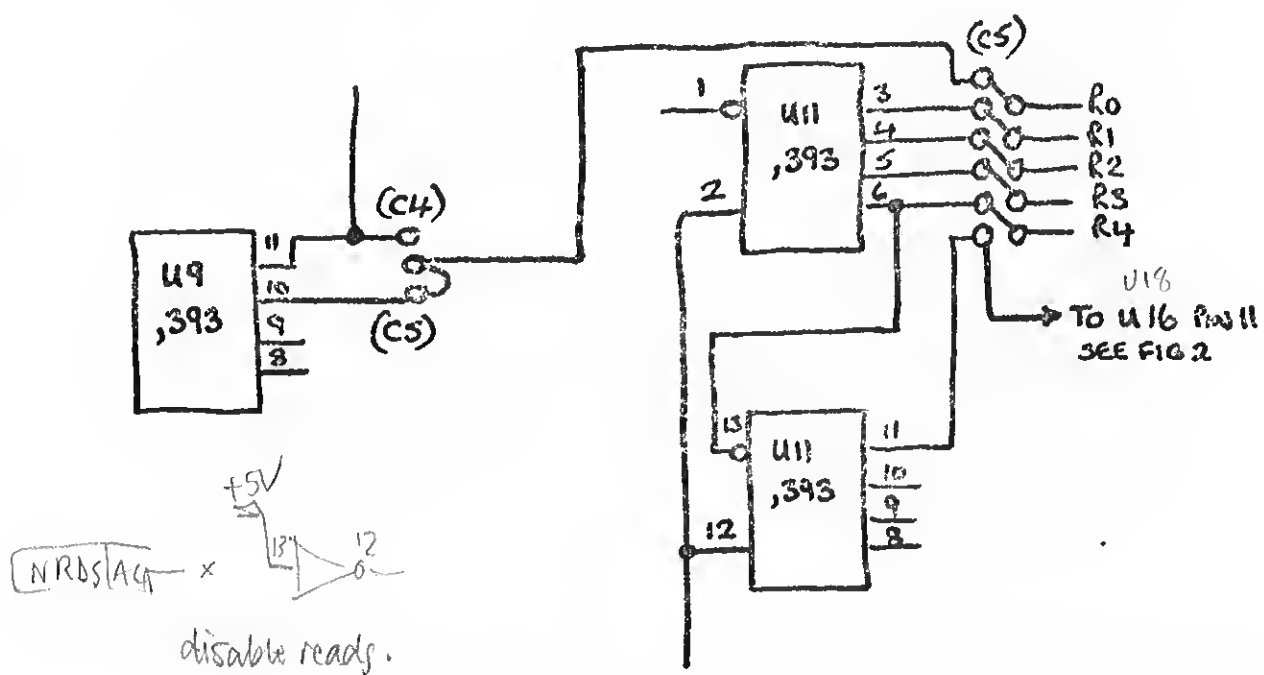
VDU 2K FIG 2



VDU 2K FIG 3



BEFORE



AFTER

VDU 2K

FIG 4

Comments on the VDU-K modification, from the VDU-K Designer.

As always, I am astonished at the dedication and enterprise shown by the users and the users' group. Especially the ubiquitous "B.E.", who is to be congratulated on the excellence and presentation of the article on his VDU-K modifications.

The first thing to consider is: "Is it worth it?". This certainly depends on the proposed application of the system. The official format for Interak 1 is still 32 x 24 (an inheritance from the original "Kemitron" VDU-A, B, G, cards of many years ago, and still in use in a lot of systems). Of course 32 characters is only any good for what it is good for, and to be fair it is good for a lot. (Fast screen displays, excellent quality on any TV set, and good size characters for excellent legibility, especially announcements and child education work).

But for the lone computer user, who has abandoned his TV for a video monitor, and is only interested in long nights listing programs, huddled up with his nose pressed up against the screen (in other words a perfectly normal computer user), more characters per line are certainly desirable. If CP/M and disks are contemplated then I could go further and say that more characters are not only desirable, but essential. "Interak X", where "X" is >1, will be a development of Interak 1 and will certainly pay close attention to these needs, probably having an 80 x 25 format, but Shh! we shouldn't mention what we haven't got; for the time being this modification is an excellent stop-gap.

It is interesting that it only costs a couple of pounds and a bit of time; a perfect example of the things that can only be done on a machine like Interak, (of course a cynic might say it's only on a machine like Interak you have to do these things!)

I must admit modifications of this nature did cross my mind when the card was being designed, and that is why the double-frequency 12MHz clock was provided, and a few of the holes that are needed for links on the circuit board. It was designed in an emergency, as there was a severe risk that Kemitron's supply of their VDU-A, B, G, cards would not be replaced once it was exhausted, thus leaving the system without a VDU interface, and in consequence not everything needed for this modification was laid down in track.

But I'm wandering, back to the comments:

1. By far the majority of the modification is involved with the provision of the extra RAM for 64 x 24. If the extent of the modification is limited to 64 x 16, there is already enough RAM on the card, and all the really hard and dangerous work needn't be carried out.

(Users of 64 x 16 will be pleasantly surprised to find that in the current issue of the Timing Generator Firmware, TG02, there is already the correct program for a 32 x 16 or 64 x 16 format. Anyone can easily take a look at this format by breaking the connection between U2 pin 19 and earth, connecting it instead to +5V via the connection pads provided.)

If only 16 rows of characters are displayed on the screen then the margins top and bottom are a bit over-generous (big). Users wishing to deviate still further from the straight and narrow (literally), can replace U10, 74LS290, with a type 74LS293, which will make the display fill the screen top to bottom again. Further attention will be needed to the Timing Generator EPROM; suitable firmware is available, called TG03.

2. I always hate the sound of track-cutting (it doesn't look too good either), and an alternative to B.E.'s method is to bend the affected leads of the ICs involved out slightly, so that they miss the socket when they are plugged in. This should be pretty easy for many people, who manage to do it plenty of times even when it's not required.

Then the new connections can mostly be just wired in, as there is no danger of contention with the old connections.

3. More than the sound of track-cutting, I hate the sound of removing IC sockets. (It always ends in tears: boo-hoo type, or rrrrip type; either way not a pretty sight!) It does occur to me that rather than remove the socket for U16 to make the modifications, it might be better to bend pin 9 of U16 so it doesn't go into the socket, and abandon that section of U16 altogether. By some happy chance there is a section of U17 which is spare, and which can be used instead of the nasty part of U16, so saving the effort of removing the socket for U16. I wouldn't mind betting about 4 of the 5 hours B.E. says the job takes is spent removing and replacing the socket! Don't do it unless you really have to.

Incidentally notice that B.E. says use a desoldering tool not braid. I think he's right - I don't think much of the technique I've heard at least two customers describe of removing solder from a hole by drilling it out; the plated-through holes on the card may not be so well plated after that kind of treatment.

4. Regarding the suggestion of using two VDU-K cards, one for each of the chosen formats: What a great idea - we sell boards. (Memo: double that lad's commission!)
5. There is a teeny weeny objection to the modification, and this is only because I'm a pedant - I don't care whether

or not it works in practice, I just want it to work in theory. The objection is that a minor contention occurs on the data lines of the RAMs during a write cycle to the modified circuit. See the bottom of page 2-22, and the top of page 2-23 of the VDU-K Manual (VDUK-1/1 Issue 1.1 October 1982) for a fuller nit-picking commentry.

In summary, think about what you want to do with the computer. For "normal" use, stick to the official 32 x 24 format. Development work is always proceeding, and sooner or later an "official" 80 x 25 VDU is bound to appear, for very serious use with disks in mind.

If you have your own special application for the computer, and are capable of writing your own software, then a very easy modification (compared with the difficult one) is to alter the VDU-K for 64 x 16. As it is fairly easy to do, this could be considered the semi-official format, especially for floppy disks. You won't have to write all your own software, as I'm sure modified versions of existing programs for Interak 1 can be made generally available.

The ultimate VDU-K modification is to 64 x 24. Although this is the most difficult, it is arguably the one most worth doing, especially for disks as it makes the humble build it yourself Interak equal to many computers costing much much more.

Although I'm a convert to 80 or more characters per line, especially for word-processing, don't think 64 is too inferior. If CP/M is used, much of the software you find is limited to only 64 characters, because people writing programs to run under CP/M daren't assume more than 64 characters, in case not everyone has them. It is quite a disappointment to the owner of an 80-character VDU to find that many of the programs he gets are cramped towards the left-hand side of the screen, with 16 blank columns to the right.

Even for word-processing use, 64 characters are often ample, if a decent margin is provided to the left and right, particularly if a printer which prints no more than 10 characters to the inch is used.

Anyway it's up to you; you pays your money and you takes your choice!

NB Now get "snow" - useless with cp/m Plus.

D.M.Parkins, Greenbank Electronics

also need total RAM so disable NRDS

DISKS ON INTERAK 1

The implementation of floppy disks on Interak 1 will be made much easier by the creation of a new printed circuit board known as the FDC-1. This new PCB will support single or double density, single or double sided, 5 or 8 inch floppy disk drives, with a maximum of four per FDC-1.

The board will be fully ISBUS compatible and will follow the law of any card in any position. The interface to the disk drives will be via a fifty way flat cable (thirty-four way for 5" drives), with drives daisy chained along its length.

To give you some idea of the added power that this PCB brings to the INTERAK system, consider running a double-sided dual density single disk drive. This would give you access to a Megabyte of random access memory, with the advantage of virtually instantaneous backups of the current task. (The data transfer rate being 500 kilo-bits per sec in double density).

To handle this exciting piece of hardware, new software has been developed, allowing minimum disturbance to the existing system and no loss of current facilities. i.e. With or without disks your INTERAK is compatible with all of the others.

To enhance your system with disks, you replace the program held in the ZYMON EPROM currently at address E000H with a new "hardware link" EPROM. (The ZYMON monitor is not lost, it is now provided 'on disk', down loadable as a 'COM' transient command).

The intended INTERAK disk operating system will be CP/M. This is virtually the 'industry standard' DOS, and opens the door to many powerful tools and programs. Consider the 24K Microsoft BASIC, or perhaps you prefer PASCAL! These and many other programs are available under CP/M. There is some doubt about what "CP/M" actually stands for; two possibilities I have heard are "Command Processor and Monitor", or "Control Program for Microcomputers".

Of course you don't have to have CP/M to gain the outstanding benefits of disks. The FDC-1 allows access to a vast amount of fast non-volatile storage, and it is up to you to decide how this can be best applied to your system. Programming the card is a matter of talking to it via ports, so utilisation such as a cassette drive replacement is perfectly possible. In fact if you only have sufficient funds for a single disk and the FDC-1, then a very powerful computer could be conceived without any software other than the ZYMON monitor.

Certainly a first pass implementation could be just one drive, with the future enhancements still available when funds permit. To take that one stage further, a good replacement for ZYMON, say DEMON, a monitor with a disk, could be written by an enterprising user and sold to other INTERAK users to offset the cost of his own disk drive.

Now we come to the subjective part of this discourse. 5 or 8 inch disks, and which to use.

I prefer single sided 8 inch units. . . Why? . . .

A disk drive needs several things to make it work, like a drive motor, a mechanism for holding the diskette, a read/write head, and a stepping motor for track seeking. It also needs logic to read/write/seek, and a metal structure to hold it all together. Now, I cannot see how reducing the diameter of the diskette eliminates the need for all of that. So how is a 5" drive that much cheaper than an 8" drive?, or if a 5" drive needs all of the things that an 8" drive has, what's left that can be used to cut the cost?

To me it has to be the standard of construction.

For instance . . . for cheapness they often use a 12 volt motor to drive the diskette in a 5 inch drive, the life-time of these motors is very limited so that the motor has to be turned off whenever it is not in use. On the 8 inch it's a mains operated brushless synchronous motor with no life-time problems, and frequency locked to boot!!

My decision on which size to buy resolved to the length of time I expect the machine to last, with the level of performance that storing several hundred kilo-bytes of data demands. I required reliability over an unknown time period and so I opted for the strength and reliability of 8 inch units.

The argument over single/double heads is much the same . . .

Given that a single headed drive loads a felt pad against the disk to press it up against the fixed head, than a two headed drive must have head number two in the place where the pad was! I don't fancy having a delicate read/write head banging up and down all day long and so I bought single headed drives. Also given double density, 500 odd kilo-bytes is enough to trust to one diskette, I'd rather put in another diskette and spread the risk. (It doesn't cost much more as single-sided diskettes are cheaper than double-sided anyway.)

Is 1 megabyte on one diskette better than 1 megabyte on two? . . . That is the question to answer.

Finally, let me please stress that all of the above is only my personal opinion, it is offered with the best of intentions. As with all INTERAK related decisions, the choice is yours, the system is designed to allow you the choices.

BYE

B.E.

The Greenbank Connection.News.

Now here's a novelty, we're actually offering news for the newsletter:

Although those nice chaps at Greenbank never have enough time to get their work done, mainly due to chatting to all those nice chaps the customers (usually explaining why they never have enough time to get all their work done), they have been thinking of and even producing some nice new cards. (More have been thought of than have actually been produced I will admit!)

Actually available, and in stock at the time of writing, is a boring, but nevertheless useful card. (It was pretty easy to design this one). It is an "extender card". You solder a socket to one end of it, and plug the other into the bus, to make it easy to work on Interak cards which can then be operated outside the rack. Note that the extender is only really used for fault finding, and setting up any cards which need adjustment; since, due to the very high speeds a 4 MHz Z80A works, cards on the extender may not work perfectly, e.g. RAMs can start dropping bits (messy!), or a VDU can fill up with garbage when it's scrolled, and so on, but nevertheless I wouldn't be without mine.

Disks. (Not again?)

Some attention was needed, and has been given, to the arrangements for adding floppy disks to the system. Hitherto the Kemitron DC-4 card has represented the normal route to disks, but has not sold at all well because its manufacturer Kemitron Electronics only let it be supplied as a built and working card, at a price of a couple of hundred pounds or so. There is a clear need for a "Bare Board" disk controller, at a more modest price, and this will be Interak's very own FDC-1. Theoretical work is proceeding very nicely: grateful thanks to messrs (note I don't say messers) R. Eldridge, M. Orton, and W. Schroeder, and others, for their valuable contributions regarding the best formats and algorithms to use.

Baby's First Words. (Expletive Deleted)

Another piece of fun is imminent for the select council of Interak elders who love to trail blaze; (to join the council of elders just promise to work day and night developing new additions for Interak, and pay me all your money to buy the pieces to do the job). They've just got hold of, at enormous expense, some lovely new speech synthesis chips, and the race is on for the user who will be the first to hear Interak's voice. What will Interak sound like? Will (s)he be snooty and stuck up, constantly telling us "Now please fasten your safety belts", or will he be earthy and fun loving "Let's have another go at Dice Pontoon, or Space Haemorrhoid, sorry I mean Asteroid, Attack"?

Laugh. (I would if it wasn't so sad)

People (non-Interaks) have been plaguing us continually with requests for eight 4532s, (meaning 32K x 1 RAM chips, not the 4532 CMOS logic devices). Multiplexed address dynamic RAMs tend to go up in four-fold increments, i.e. 4K, 16K, 64K, 256K, and so on, a consequence of 0 and 1 logic levels, and row and column addressing (0 plus 1 plus row plus column = 4 times the addressing space for each extra pin allocated).

If that's so who would bother to make a 32K Dynamic RAM? If they know how to make 64Ks already, and they're working on 256K, why bother with the backward step to 32K? Rejects that's what I reckon it is; they try and make a 64K RAM, and if they only get it half right then bingo they've made a 32K RAM. Now who would design a computer to take rejects? Uncle Clive! (It's amazing how many nephews that man has, I've personally met dozens of them myself - no wonder we never hear of Uncle Clive's brother, he's taking a well-earned break after all those children).

A big enough buyer would be able to buy up all the rejects, and would have a virtual monopoly of the 32K upgrade market, so nobody else could do the upgrades - there's method in his madness! he only catch is the chip manufacturers can't make enough reject 64K RAMs, and so they've had to start new production lines making rejects to order. (Now that's a job that I've got a natural aptitude for: mass producing rejects!)

But why would I laugh if it wasn't so sad? The reason is that so many poor souls are upgrading their computers, not with the 4532 memory but with the 4532 CMOS logic chip! We have intercepted many potential disasters because we have had enough wits about us to ask what people suddenly want 8 priority encoders for, and then the sorry tale comes out: "Sinclair wants fifty pounds to upgrade my Spectrum, so I thought I'd buy the 4532s and do the job myself as they're only 70p each". What a mess!

D.M.P

Microdrives

Talking of mon oncle I know people in glass houses shouldn't throw stones, but I can't resist it!

Have you seen the latest Sinclair "Spectrum" adverts.? It looks as though they're improving on delivery. A few months ago the section referring to the ZX Microdrive said "Coming soon . . . later this year", now it reads "Coming soon . . . early part of 1983". What's that old saying? This year, next year, sometime, never?

As I said, people in glass houses shouldn't throw stones, but it's comforting to know that even a genius (and multi-millionaire) gets it wrong sometimes.

On this subject, what do you suppose a Microdrive is? According to the adverts. each "Microdrive" is capable of holding up to 100K bytes using a "single interchangeable microfloppy" (according to the old adverts.) or a "single interchangeable storage medium" (according to the latest adverts.)

I notice the transfer rate is 16K bytes per second, with average access times of 3.5 seconds.

Now we have some figures to work on: If the "interchangeable storage medium" stores 100K bytes, and transfers them at the rate of 16K per second, how long does it take to transfer a whole 100K? (Anybody any good at maths out there?)

I make it 100K divided by 16K = about 6 seconds, and probably there'll be some extra bytes required in order to provide 100K useable bytes, so bump the time taken up to 7 seconds.

Aha, we're getting somewhere: More maths: If it takes between 0 seconds and 7 seconds to access a storage medium full of data, how long does it take on average?

How about $(7 - 0)/2 = 3.5$ seconds, exactly what it says in the advert!

It strikes me that a loop of tape 7 seconds long would suit this specification; if you're lucky the data you want is right at the beginning (i.e. 0 seconds away), but it could be as long as 7 seconds away: average 3.5 seconds, Q.E.D.

Of course, he said, hedging his bets, the original advert. did say they used a "microfloppy", which would be a good selling point, but if so why describe it now as a "single interchangeable storage medium"?

Anyway, if it is a microfloppy (which it should be according to the original ads., unless they're looking for another slap on the wrist with a feather by the Advertising Standards Body) it is a pretty clever idea (or stupid, according to your point of view), to record all the data in one long stream, possibly a spiral, like an ordinary audio record, rather than in separate tracks like "our" floppy disks.

With traditional Sinclair design, the one motor could be made to both turn the disk, and move the recording head radially, and thus save the expense and precision of a stepper motor, lead screw, opto sensors etc. as found on old fashioned disk drives, as used by the rest of the world.

The system used by most CP/M compatible machines, including ours, uses sectors of data located on concentric (not spiral) tracks, recorded in a format originated by IBM, but they probably don't know much about computers. Perhaps they know a bit because the average "latency" is reduced to 0.083 seconds, and access time 0.006 seconds track to track on a floppy disk which can store up

to 1M byte, and still only cost a few pounds.

All I can say in conclusion is that the prices of "genuine" disk drives are dropping all the time, so he'd better not leave it too long!

Remember, if one of the above predictions is right, you saw it first in "Interaktion"; if they're all wrong please say you saw them somewhere else!

O.M.P

Knock Knock. (who's there? Sour Grapes)

I really must have got out of bed on the wrong side this year, because there's more "knocking copy" I have for your amusement.

This time it concerns Acorn. I won't say what's in my mind, I'll just present the facts, and leave you to draw your own conclusions:

Fact 1: On Page 40 of Electronics Today International for February 1983 is a full-page advert which says (and I quote):

"Volume purchase from Acorn brings massive savings for you!" Cash in on our misfortune! Over £50 off an Atom Microcomputer. We recently made a bulk purchase of over 800 Acorn Atoms for sale overseas. The deal fell through! We are now offering those Atoms to you at the price we paid for them. . . . incredible saving of £59.50 plus a free power supply worth over £20 . . . wide range of additional interface boards available to fit inside the casing . . . etc. etc."

The advertisement appears to be placed by a firm called (note this) "Computer Marketplace Ltd., 20 Orange Street, London WC2H 7ED"

Fact 2: On page 95 of the same issue of the magazine is the advertisers' index it says (and I quote):

"Acorn Comp. 40"

Fact 3: Exactly the same thing happened in at least one other magazine published about the same time.

What a silly firm this "Computer Marketplace"; fancy buying over 800 Atoms for sale overseas without getting a letter of credit first - no wonder we've never heard of them before. (You don't suppose they'd like some Interaks as well do you?) And what silly magazines, publishing the wrong names in the advertisers index; how could they have got the idea the adverts. were being placed by Acorn?

D.M.P

Thanks Norman!

Nothing to do with Interaktion really, but as Norman (Norman Gale in Lincs) is a member of the group I thought I could reach him through these columns to say thanks for a gift he made me. I just happened to express a need (a "why doesn't someone make a small drawing board that isn't a load of rubbish, and doesn't cost the earth?"), and what should arrive through the post but a home made drawing board, made from ordinary household articles (string, curtain wire, glue etc.) designed in such a way as to give precision performance without the need for precision materials. Thanks Norman!

I wish I could say here is an example of an up and coming young designer, with the sort of new ideas we need, but, I hope Norman won't mind me saying this, he is one of the old school, being near retirement age. He could certainly teach me a thing or two!

He says he has a "butchered ZX81" (never mind, all ZX81 users feel like taking an axe to their computer some days), and is an inventor, having designed special aids for the disabled. Just think what he will be able to do if he builds an Interak.

Incidentally he is a member of MENSA, but as Clive Sinclair is its president it looks like you no longer need any intelligence to join! (Just kidding, Uncle, from your "nephew" David.)

Our Fame is Spreading

Although it does sound a little like a slogan for margarine, our fame is spreading. Interak is more well-known than many people think. We don't have to go round plastering our name all over the place, Interak is not that kind of product; it is something you buy voluntarily, you don't have to be sold it. I may be overstating the case, but you see adverts for Fords and Vauxhalls don't you - you never see adverts for Rolls-Royce!

One nervous potential user was considering whether or not to buy Interak, and was discussing it with the Microprocessor department staff where he worked. He thought they wouldn't have heard of Interak, but they all had, and gave him their opinion. (What did they think? Not entirely complimentary, but in the interests of honesty this is what they said: "Interak? A great idea and system, very reasonably priced, but a bit old-fashioned." I think that's a pretty fair comment - "a great idea", and "very reasonably priced"; I think we'll accept that won't we?, but we're working on the "old fashioned" jibe. New cards, still on the drawing board, waiting for the chips to become cheap enough and available enough to use, will perform a miraculous transformation to the system once they are produced.

Anyway, I'm not even certain I do consider the term "old-fashioned" as censure; after all someone who does business in the "old-fashioned" way, or has "old-fashioned" manners, isn't necessarily all bad. We actually claim as a benefit that Interak is built in a "traditional" manner, and "traditional" in a way is a synonym for "old-fashioned".

CALAMITY GULCH (no connection with Silicon Valley)Error Number 1

Interaktion Newsletter Number 1, page 2. The hex. dump of hex. dump has two typing errors in it (no wonder nobody's sent me any any programs so far!) The errors are as follows:

Address 80A6 Data should be 3E, not 3A as printed

Address 80BE Data should be 7C, not 76 as printed

The errors are fairly catastrophic, so it's funny that only one person has reported them; some of you boys aren't doing your homework!

Error Number 2

There is one (plus another, to change the version number) byte wrong in ZYMON 2.VDD2. The current version being supplied has the error corrected, but all users should make sure they have version V003 or later. (If you have been supplied with the earlier version, contact your supplier for advice. Re-programming will be carried out free of charge, don't worry about the expense, we will knock it off the royalty payments to ZYMON's author, after he's been keel-hauled!)

Address 03E9 Data should be F2, not C2 as supplied

To alter the sign-on message to display the appropriate new version number, make the following alteration at the same time:

Address 0776 Data should be 33, not 32 as supplied

It is unlikely that any catastrophes will have been precipitated, since the consequence of the error is that when tapes are being loaded the contents of any RAM at Address location C2E0 will have been corrupted; fortunately Interak 1 doesn't have any RAM at C2E0.

Credit where credit is due, the man who reported this error is: Mr. J. Walker, Managing Director of Electronic and Technical Services. To anyone who discovered it before Mr. Walker: you rat, why didn't you tell us!

MEMBERS' LETTERS

Chris Evans
18 Wilderswood Av.
Horwich
Bolton
Gtr. Manchester.

Writes asking for information about disk drives and assemblers, I hope this issue helps. He has copies of Forth and Lisp that he wants to get running on Interak, so if you can help get in touch.

By the way Chris are you on the phone ?

DR. A.S. Hundal
Dartford
Kent.

Submits the following alternative to French/English conversion program published in the Issue 1. It has the advantage of reducing the DATA statements in the program by 1/3.

```
1 CLS
10 A$=INPUT$
12 GOS.1000:REM as in newsletter 1
15 RESTORE
20 FOR L=1TO3D
30 READ B$,C$
40 IF A$=B$ G.80
50 IF A$=C$ G.100
60 N.L
70 G.10
80 P.C$
90 G.110
100 P.B$
110 P.A$
120 G.10
999 S.
3000 DATA "one","une","two","deux",
        "three","trois" etc.....
```

He also asks if the following is a legitimate Basic instruction:

```
104D D = D DR 32
```

I have not seen the logical OR function used in this way before and ZYBASIC does not like it, I'm not sure about other BASICs.

Finally you ask about mixing assembly language with BASIC; by assembly I assume you mean machine code. Yes you can: store the coding in a data statement and use POKEs to place it in memory, then you can use the CALL or USR instructions to execute the program. It is wise to save the registers before executing and then restoring them before returning to BASIC.

PRINTING SERVICE If you haven't got your own printer, have your software listed. As many copies as you want. Charged at cost. HEX. or BASIC . Send your orders to the Users Group.

FOR SALE

Mr.R.BROADBERRY
11,DUCIE RD.
STAPLE HILL
BRISTOL
BS 16 5JZ

BOARDS FOR SALE

SC/MP System.

VDUA, VDUB, VDUG
MPA 7 (SC/MP buffered)
MXA 1 2102's 2K
MXA 3 2114's 8K
PRM 8 ROM with BASIC & utilities
DCR 6, KB i/f
TPA Tape i/f
PP2 PROM Programmer

Z80 System.

VDUA, VDUB, VDUG
MZ 1 A Simple Z80
MZ B 3 Power on Jump (ZMON)
MX D 2 16K Dynamic RAM X 2
PRM 8 ROM empty
DCR 6 KB i/f
SIO 2 Twin RS 232 Serial i/f

Get in touch directly or phone me with offers. P.V.

FOR SALE

D.M.Parkins,
GREENBANK ELECTRONICS,
92 New Chester Road, New Ferry,
Wirral, Merseyside. L62 5AG Tel:- 051-645 3391

FOR SALE: Unused Texas Instruments 64K Dynamic RAM evaluation kit, i.e. Texas 4500 single chip dynamic RAM controller + 8 Texas 150ns 64K 5V 16-pin RAMs + interface and circuit design notes for all popular microprocessors. £49.00 + VAT. One only.

Software Library.

(Some programs are for sale, others are free, please enquire.)

<u>NAME</u>	<u>DESCRIPTION</u>	<u>AUTHOR</u>	<u>CODE</u>	<u>SUPP.</u>	<u>FORMAT</u>
ZYMON	INTERAK monitor	BE	MC	GB	A,C
ZYBASIC	INTERAK BASIC	--	MC	GB	A
HC DISASS	Simple Disassembler	HC	MC	GB	A
ASM 32	Editor Assembler	--	MC	UG	A,C
VELTEXT	Text Editor	PV	MC	UG	A,C
MONSTER MASH	Maze Game	BE	ZB2	UG	A
RAKOVSKY	CHESS	--	MC	UG	A
AC10.XX	(Chess Character EPROM for VDU-K)	--		GB	A
Happy Sums	Fun maths	PV	ZB2	UG	A.
Hangman	Spelling game	PV	ZB2	UG	A
O's and X's	Game	PV	ZB2	UG	A
Pools Pick	Random Draw Selector	PV	ZB2	UG	A
Count	Learn to count	PV	ZB2	UG	A
Dice Pontoon	Simple Game	PV	ZB2	UG	A

Key: MC machine code. ZB2 ZYBASIC. GB Greenbank. UG User Group. Formats:
A = 32 x 24 VDU-K, B = 64 x 16, C = 64 x 24 VDU-2K.

(Depending on the number of users requiring software, it may be necessary to levy a small charge for copying even the "free" programs, towards postage, cassettes, etc.)

Well I hope you enjoy this issue. Please send in your comments and your programs large and small.

P.V.

IMPORTANT ERRATA

VDU-K Manual

Issue 1.1 Page 5-12:

Top left-hand corner of circuit diagram: "U16" should read "U18".

Bottom left-hand corner of circuit diagram: "U18" should read "U16".

User Group Newsletter No. 2

Pages 18, 21:

Delete all references to U16;
insert instead U18.

Note:

VDU-2K Modification:

Newsletter No. 2, Page 18, sixth paragraph:

There is no need to remove the socket to break the track to pin 11 of the affected integrated circuit. The track is the thick one which emerges between pins 1 and 16 on the socket side of the board, and it may be cut at this point instead. (The IC is shown as U18 on page 5-16 of the current VDU-K Manual.)

Greenbank Electronics

May 1983